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**APPARATUS AND METHOD FOR MULTI-THREADED
PASSWORD MANAGEMENT**

BACKGROUND OF THE INVENTION

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1. Technical Field:

The present invention is directed to an improved data processing system. More specifically, the present invention is directed to an apparatus and method for multi-threaded password management.

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2. Description of Related Art:

Employees of companies are often required to use several different passwords to access different resources needed to perform their duties. Although the user identification is usually the same for all the resources, the passwords must in general be different. This requires that the employee memorize a number of different passwords as well as which passwords belong to which resources.

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An additional burden is that in general all these passwords expire at different times. Thus, the employee is required to go through the process of generating a new password a plurality of times. It would be beneficial to have an apparatus and method by which the number of different required passwords, as well as the total number of times these passwords must be reset.

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SUMMARY OF THE INVENTION

5 The present invention provides an apparatus and
method for multi-threaded password management. With the
apparatus and method of the present invention, resources
may be grouped into families of resources. A family of
resources is defined as a group of resources that may
10 make use of the same password.

When a user sets a new password for a family of
resources, all of the passwords for each of the resources
in the family are reset to this new password. That is,
the multi-threaded password management apparatus and
15 method of the present invention spawns threads to reset
the passwords of the other resources in the family. In
this way, a single operation of resetting a password for
a resource in the family may cause a plurality of
passwords to be reset.

20 Moreover, the passwords need only be reset when the
earliest reset time of the resources in the family
occurs. Thus, the number of passwords that must be
memorized by a user is significantly reduced.
Furthermore, the number of times that passwords need be
25 reset is also reduced due to the resetting of passwords
on a group level.

BRIEF DESCRIPTION OF THE DRAWINGS

5 The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed
10 description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 is an exemplary block diagram illustrating a distributed data processing system according to the present invention;

15 **Figure 2** is an exemplary block diagram of a server apparatus according to the present invention;

Figure 3 is an exemplary block diagram of a client apparatus according to the present invention;

Figure 4 is an exemplary block diagram of a
20 multi-threaded password management apparatus according to the present invention;

Figure 5 is a flowchart outlining an exemplary operation of the present invention when generating groupings of resources; and

25 **Figure 6** is a flowchart outlining an exemplary operation of the present invention when updating resource group passwords.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

5 With reference now to the figures, **Figure 1** depicts a pictorial representation of a network of data processing systems in which the present invention may be implemented. Distributed data processing system **100** is a network of computers in which the present invention may be
10 implemented. Distributed data processing system **100** contains a network **102**, which is the medium used to provide communications links between various devices and computers connected together within distributed data processing system **100**. Network **102** may include
15 connections, such as wire, wireless communication links, or fiber optic cables.

 In the depicted example, server **104** is connected to network **102** along with clients **108**, **110**, and **112**. These clients **108**, **110**, and **112** may be, for example, personal
20 computers or network computers. In the depicted example, server **104** provides data, such as boot files, operating system images, and applications to clients **108-112**. Clients **108**, **110**, and **112** are clients to server **104**. Network data processing system **100** may include additional
25 servers, clients, and other devices not shown.

 In addition to the above, various resources are coupled to the network **102**. These resources may be, for example, printers, storage devices, servers, and the like. In the depicted example, the resources include printers
30 **114-118** and storage devices **106** and **120**. These resources are accessible by the client devices **108-112** via the

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network **102** and server **104**, for example. The resources may have security measures associated with them, such as password protection, or the like, that is used to limit access to the resources to only those users that are
5 authenticated through an authentication process. For example, a user must enter a valid user identification and password to obtain access to the resources.

In the depicted example, distributed data processing system **100** is the Internet with network **102** representing a
10 worldwide collection of networks and gateways that use the TCP/IP suite of protocols to communicate with one another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers, consisting of thousands of commercial,
15 government, educational and other computer systems that route data and messages. Of course, network data processing system **100** also may be implemented as a number of different types of networks, such as for example, an intranet, a local area network (LAN), or a wide area
20 network (WAN). **Figure 1** is intended as an example, and not as an architectural limitation for the present invention.

Referring to **Figure 2**, a block diagram of a data processing system that may be implemented as a server, such as server **104** in **Figure 1**, is depicted in accordance
25 with a preferred embodiment of the present invention. Data processing system **200** may be a symmetric multiprocessor (SMP) system including a plurality of processors **202** and **204** connected to system bus **206**. Alternatively, a single processor system may be employed.
30 Also connected to system bus **206** is memory controller/cache **208**, which provides an interface to local memory **209**. I/O bus bridge **210** is connected to system bus

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206 and provides an interface to I/O bus **212**. Memory controller/cache **208** and I/O bus bridge **210** may be integrated as depicted.

Peripheral component interconnect (PCI) bus bridge **214** connected to I/O bus **212** provides an interface to PCI local bus **216**. A number of modems may be connected to PCI local bus **216**. Typical PCI bus implementations will support four PCI expansion slots or add-in connectors. Communications links to network computers **108-112** in **Figure 1** may be provided through modem **218** and network adapter **220** connected to PCI local bus **216** through add-in boards.

Additional PCI bus bridges **222** and **224** provide interfaces for additional PCI local buses **226** and **228**, from which additional modems or network adapters may be supported. In this manner, data processing system **200** allows connections to multiple network computers. A memory-mapped graphics adapter **230** and hard disk **232** may also be connected to I/O bus **212** as depicted, either directly or indirectly.

Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 2** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

The data processing system depicted in **Figure 2** may be, for example, an IBM e-Server pSeries system, a product of International Business Machines Corporation in Armonk, New York, running the Advanced Interactive

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Executive (AIX) operating system or LINUX operating system.

With reference now to **Figure 3**, a block diagram illustrating a data processing system is depicted in which the present invention may be implemented. Data processing system **300** is an example of a client computer. Data processing system **300** employs a peripheral component interconnect (PCI) local bus architecture. Although the depicted example employs a PCI bus, other bus architectures such as Accelerated Graphics Port (AGP) and Industry Standard Architecture (ISA) may be used. Processor **302** and main memory **304** are connected to PCI local bus **306** through PCI bridge **308**. PCI bridge **308** also may include an integrated memory controller and cache memory for processor **302**. Additional connections to PCI local bus **306** may be made through direct component interconnection or through add-in boards. In the depicted example, local area network (LAN) adapter **310**, SCSI host bus adapter **312**, and expansion bus interface **314** are connected to PCI local bus **306** by direct component connection. In contrast, audio adapter **316**, graphics adapter **318**, and audio/video adapter **319** are connected to PCI local bus **306** by add-in boards inserted into expansion slots. Expansion bus interface **314** provides a connection for a keyboard and mouse adapter **320**, modem **322**, and additional memory **324**. Small computer system interface (SCSI) host bus adapter **312** provides a connection for hard disk drive **326**, tape drive **328**, and CD-ROM drive **330**. Typical PCI local bus implementations will support three or four PCI expansion slots or add-in connectors.

An operating system runs on processor **302** and is used to coordinate and provide control of various components within data processing system **300** in **Figure 3**. The
5 operating system may be a commercially available operating system, such as Windows 2000, which is available from Microsoft Corporation. An object oriented programming system such as Java may run in conjunction with the operating system and provide calls to the operating system
10 from Java programs or applications executing on data processing system **300**. "Java" is a trademark of Sun Microsystems, Inc. Instructions for the operating system, the object-oriented operating system, and applications or programs are located on storage devices, such as hard disk
15 drive **326**, and may be loaded into main memory **304** for execution by processor **302**.

Those of ordinary skill in the art will appreciate that the hardware in **Figure 3** may vary depending on the implementation. Other internal hardware or peripheral
20 devices, such as flash ROM (or equivalent nonvolatile memory) or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 3**. Also, the processes of the present invention may be applied to a multiprocessor data processing
25 system.

As another example, data processing system **300** may be a stand-alone system configured to be bootable without relying on some type of network communication interface, whether or not data processing system **300** comprises some
30 type of network communication interface. As a further example, data processing system **300** may be a Personal

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Digital Assistant (PDA) device, which is configured with ROM and/or flash ROM in order to provide non-volatile memory for storing operating system files and/or user-generated data.

5 The depicted example in **Figure 3** and above-described examples are not meant to imply architectural limitations. For example, data processing system **300** also may be a notebook computer or hand held computer in addition to taking the form of a PDA. Data processing
10 system **300** also may be a kiosk or a Web appliance.

 The present invention provides an apparatus and method for managing passwords on a group basis. With the apparatus and method of the present invention, resources may be organized into groups based on whether or not the
15 resources are capable of using the same password and user identification. For example, if a plurality of printers, such as printers **114-118**, are available on the distributed data processing system **100**, the printers, or portions thereof, may be grouped into "families." Each of the
20 resources assigned to the same "family" may make use of the same user identification and password. Through the use of the multi-thread password management apparatus and method of the present invention, the password associated with a family of resources may be updated and thereby, the
25 passwords of each of the individual resources in the family are updated.

 The multi-thread password management apparatus of the present invention may be implemented as software, hardware, or a combination of software and hardware. In a
30 preferred embodiment, the present invention is implemented as software instructions executed by a processor.

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The multi-thread password management apparatus may be implemented in a server apparatus, client apparatus, or distributed across a plurality of devices in a distributed data processing system. In a preferred embodiment, the present invention is implemented in a server apparatus to which client devices may obtain access.

Initially, when a user first logs onto the multi-thread password management apparatus of the present invention, e.g. logs onto server **104**, the user is provided with the option of defining "families" of resources for which the user may designate a general password. The resources that may be grouped into families may be limited by parameters associated with the resources. That is, parameters may be associated with a resource that indicates what other resources may be grouped with it to form a family. Such parameters may be indications of security level, accessibility, resource type, and the like, of the resources. This feature allows a system administrator or the like to maintain security of sensitive resources by limiting whether they can be grouped with other resources and to which resources they may be grouped.

The user may be presented with a list, graphical representation, or the like of the resources. The list, graphical representation, or the like may further include an indicator of which resources may be grouped with one another. The user may then select various ones of the resources to be grouped with one another into a resource "family" and provide a name or indicator for identifying the group.

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The user may have already established passwords and user identifiers for these resources. In this case, the user may select an option to change the passwords of all of the resources in the family to a new password to be
5 input by the user. Alternatively, the user may continue to use the individual passwords until a first resource in the family requires resetting of the password. At such time, the user will again be provided with the option to update all of the passwords of the resources in the
10 corresponding family.

When a resource in a resource family has a password that is about to expire, the next time the user logs onto the multi-threaded password management system of the present invention, the user will be prompted to enter a
15 new password. The user will further be asked whether he/she wishes to change the passwords for the other resources in the resource family and may be presented with a listing or display identifying the other resources. The user may then update the passwords for all of these
20 resources, none of the resources, or select certain ones of the resources to have their passwords updated.

The listing of resources associated with the family, to which the original resource whose password is about to expire, may be obtained from a data structure that stores
25 the family associations for the user. The data structure may be stored on a server, on the client device, or the like. In addition, in one exemplary embodiment, the family associations may be stored by the resources themselves such that when a password is to be changed by
30 the user, the resources are polled to determine which resources belong to the same family as the one whose password is to be changed.

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In a preferred embodiment, however, the family data structure is stored on a server. The data structure may contain information regarding each user, the family organization of the resources for each user, and may
5 include the passwords, expiration times, resource addresses, and the like, for each family of resources and each individual resource, depending on the particular implementation.

Based on the selection of the user to either update
10 all, none, or some of the resources in a resource family, the multi-thread password management system of the present invention will initiate one or more processes that spawn threads to change the passwords for the selected resources. The processes use the resource organization
15 defined by the data structure as well as the resource address information from the data structure, to initiate processes for changing the password for the resource. Alternatively, in a preferred embodiment, the password associated with the resource may simply be updated in the
20 data structure rather than having to update the password on the resource itself. In this way, the user may update a plurality of passwords from a single password update entry.

Furthermore, for each of the resources whose
25 passwords are updated, the time for expiration of the password may be set to be the same. However, in some systems, the password time period may be different for different resources and the updating of the password may reset the valid time period but the time period may be
30 different from other resources that are also updated at that time.

Figure 4 is an exemplary block diagram illustrating a multi-thread password management system according to the present invention. The elements shown in **Figure 4** may be
5 implemented in software, hardware, or a combination of software and hardware as mentioned above.

As shown in **Figure 4**, the multi-thread password management system **400** includes a controller **410**, an access authorization device **420**, a network interface **430**, a
10 password profile storage device **440**, and a memory **450**. These elements are coupled to one another via the control/data bus **460**. Although a bus architecture is shown in **Figure 4**, other architectures may be used that facilitate the exchange of control/data signals between
15 the elements **410-450**, without departing from the spirit and scope of the present invention.

The controller **410** controls the overall operation of the multi-thread password management system **400** and orchestrates the operation of the other elements **420-440**
20 based on one or more control programs stored in memory **450**. The controller **410** receives a request for access to resources from a client device via the network interface **430**. The controller **410** may respond by requesting that the user enter a user identification and password.

25 Upon receiving the user identification and password, the controller **410** forwards this information to the access authorization device **420** which authenticates the user identification and password based on information stored in the password profile storage **440**. The password profile
30 storage **440** stores information regarding user identifications and corresponding password(s) for

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resources on the network. The password profile storage **440** preferably stores the resource passwords for each of the resources as well as families of resources. For example, the password profile storage **440** may store a
5 separate record for each user identification having separate fields for each resource coupled to the network. These fields may further include fields that identify which family the resource belongs to.

Based on the particular password entered by the user,
10 the multi-thread password management system **400** may authorize the user to access a particular resource or family of resources. An indication of the resource(s) to which access is granted may be provided to the user via the network interface **430**.

15 In addition, the access authorization device **420** may determine whether a password is to be updated. If the password is to be updated, the access authorization device **420** may send a message to the user via the network interface **420** prompting the user to enter a new password.

20 In addition, the access authorization device **420** may ask the user to indicate whether the user wishes to update the passwords for all, none, or some of the other resources associated with the resource family. Based on the user's selection, the access authorization device **420** may

25 initiate processes to spawn threads to change the passwords for each of the selected resources. These threads may simply update the password for the family of resources or the individual resources in the password profile storage **440**, may perform functions to update the
30 password on the resource(s) themselves, initiate update operations on the client device, and the like, depending on the particular implementation. In a preferred

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embodiment, the threads update the passwords in the password profile storage **440**.

Figure 5 is a flowchart outlining an exemplary operation of the present invention when generating families of resources. As shown in **Figure 5**, the operation starts with receiving an initiation of the family password management from a user (step **510**). The resources to which the user is granted access are determined (step **520**). The determination of resources to which the user is granted access may be determined in any number of different known ways, including querying a database in which user access levels and corresponding resources are identified.

A determination is made as to whether the user already has an established user password profile (step **530**). If not, a new user password profile is created (step **540**) and a determination is made as to which resources to which the user is granted access may be grouped together (step **560**).

If the user already has an established user password profile, the user's password profile is retrieved (step **550**). The listing of resources is then displayed (step **570**). If the user already has an established password profile, the display of the listing of resources may include displaying the listing of resources from the user's password profile with indications of which resources are grouped with one another and which resources may be grouped to one another. If the user does not already have an established user password profile, the listing may include indications of which resources may be grouped to one another.

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The user may then manipulate the groupings of the resources using a graphical user interface or the like (step 580). The user may further enter resource group names, password information, and other information (step 590). The display of the listing of resources and their associations may be updated as the user performs operations to manipulate the groupings (step 592).

A determination is then made as to whether the user enters an update command (step 594). If not, the operation returns to step 580. If so, threads are spawned to update the password information for each group that was modified by the user using the graphical user interface (step 596). The operation then ends.

Figure 6 is a flowchart outlining an operation of the present invention when a user updates a group password. As shown in **Figure 6**, a user attempts to access a system resource and enters a password for accessing the system resource (step 610). The password entered by the user is validated (step 620) and a determination is made as to whether the password is about to expire (step 630). If not, the operation ends. If the password is about to expire, the user is presented with a graphical user interface for providing a new password (step 640). The new password is validated (step 650) and an option is presented to the user for updating all of the passwords for the resources in the resource group (step 660). The option may include a listing of the resources that will be updated if the user so chooses. Alternatively, the user may be allowed to choose which of the resources may have their passwords updated from the listing of resources presented.

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A determination is made as to whether the user elects to update passwords for other ones of the listed resources (step **670**). If the user elects to update the password for other resources in the resource group, threads are spawned
5 to update the passwords (step **680**). If the user elects not to update the password for the other resources, the password for the resource having the expired password is updated (step **690**) and the operation ends.

Thus, the present invention provides an apparatus and
10 method for updating passwords on a group basis. The apparatus and method of the present invention allows a user to define groups of resources that may use the same password and update the password as a group. In addition, the present invention allows a user to select various ones
15 of the resources in a group for which the user wishes to update an associated password.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary
20 skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of
25 signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media such a floppy disc, a hard disk drive, a RAM, and CD-ROMs and transmission-type media such as digital and analog communications links.

30 The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the

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invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention,
5 the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.